



HORIZON EUROPE PROJECT: Achieving good environmental status for maintaining ecosystem services by assessing integrated impacts of cumulative pressures (GES4SEAS)



Contract no. 45 PHE/2024 - CNCS - UEFISCDI within PNCDI IV

Duration: 22.01.2024 - 31.12.2024

Coordinator: Dr. Oana Marin

PROJECT DESCRIPTION

Marine macroalgae aquaculture can provide an algal biomass that can be used as a source of bioactive compounds with applicability in various fields, prioritizing human well-being and promoting a circular economy. Marine macroalgae from the Romanian Black Sea coast provide many ecosystem services, being a special resource due to their biologically active compounds. A capitalization of algal material can provide many benefits to society. Green algae *Ulva* spp. contain specific polysaccharides, giving them pharmaceutical value and physiological benefits, due to their ability to prevent certain diseases, such as inflammatory disorders, viral and antibacterial infections, while acting as immunomodulatory and hypolipidemic agents. In this project, algal material from fresh algal deposits (green algae *Ulva* spp.) will be used to extract ulvans, important compounds with multiple active principles and practical applicability, having immunomodulatory, antioxidant, anticancer, anti-inflammatory, antiviral, antidiabetic, anticoagulant and cytotoxic activity. *Ulva* spp. special properties have increased the interest at European level for their large-scale cultivation. Cultivation of *Ulva* species, although not a traditional practice along the Romanian Black Sea coast, represent an aspect that can provide major benefits to society through the subsequent exploitation of a superior algal biomass in terms of composition, compared to that of the natural environment. *Ulva* spp. are excellent candidates for aquaculture. To support the current European initiative, the project will perform an experimental culture under laboratory-controlled conditions with the aim of testing techniques for controlled reproduction and growth in the laboratory. The main purpose is to provide a constant source of algal material consisting exclusively of green algae of commercial interest *Ulva* spp., for a future capitalization. Compared to algae harvested from the natural environment, this biomass has the advantage of having a superior chemical and biochemical composition.

A small-scale pilot study will be carried out, which has the advantage of being easy to monitor, at the same time offering the possibility of a complete knowledge of the reproductive cycle, an essential aspect for a future large-scale cultivation.

OBJECTIVE

The project aims to initiate a pilot study of controlled reproduction under laboratory-controlled conditions for the green algae of commercial interest *Ulva rigida* and *Ulva intestinalis*, highlighting the exploitable potential of these species from fresh algal deposits.

The project has two phases:

Phase 1: Pilot study for controlled reproduction under laboratory-controlled conditions for the green algae of commercial interest *Ulva rigida* and *Ulva intestinalis*

Duration: 22.01.2024 – 01.08.2024

Specific activities:

A1. Applying reproduction techniques for *U. rigida* and *U. intestinalis*

A2. Monitoring the evolution of *Ulva*'s intermediate development stages obtained exclusively under laboratory-controlled conditions

Phase 1 presented the results of *Ulva* culture under laboratory-controlled conditions. The experiment was carried out for two months. A daily monitoring of specimens' evolution and weekly measurements of their length in order to analyse the growth rate, was insured. Although this is a small-scale experiment with a strictly didactic purpose, to fully understand the biology and ecological requirements of *Ulva* species, the applied technique and methodologies allowed to obtain an algal material consisting exclusively of green algae *Ulva* spp., independent of the availability in the natural environment. Transition to a more advanced level (e.g. cultivation in large basins) by applying the techniques tested during Phase 1, will allow obtaining an algal biomass with exploitable potential in various fields (e.g. pharmaceutical, cosmetic) and industrial branches.

Results:

- Complete knowledge of *Ulva* spp. reproductive cycle., an essential aspect for a future large-scale cultivation.
- Access to a constant source of algal material consisting exclusively of green algae of commercial interest *Ulva* spp., independent of the availability in the natural environment.

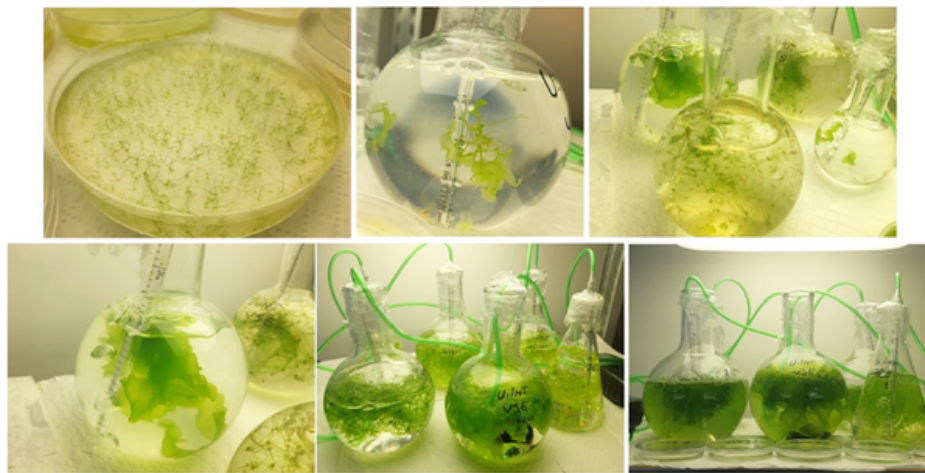


Fig.1. *Ulva* spp. culture in various flasks: from Petri dishes (top left) to 2000 ml flasks (bottom right) - original photo NIMRD “Grigore Antipa”

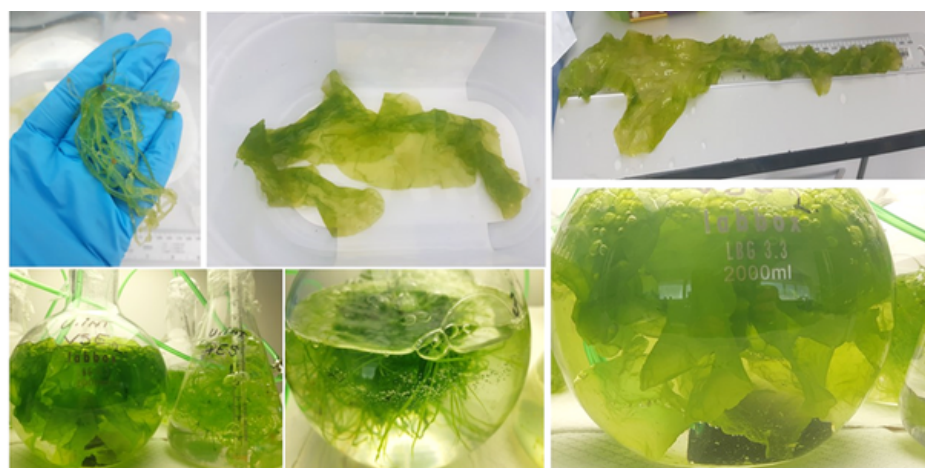


Fig. 2. Algal biomass consisting of *Ulva* species obtained under controlled culture in NIMRD laboratories during 2 months of experiment - original photo NIMRD "Grigore Antipa"

Phase 2: Highlighting the exploitable potential of green algae *U. rigida* and *U. intestinalis* harvested from natural environment (algal deposits)

Duration: 01.08.2024 – 31.12.2024

Specific activities:

- A1. Primary biochemical characterization of *U. rigida* and *U. intestinalis*
- A2. Ulvan extraction from *U. rigida* and *U. intestinalis* and comparative analysis of the results
- A3. Highlighting the antioxidant activity of ulvan extract

Results:

- Highlighting the exploitable potential of green algae (*Ulva* spp.) from algal deposits by extracting ulvans and highlighting their antioxidant activity.

The complete biochemical characterization carried in Phase 2 by highlighting the percentage of dry biomass, ash, total lipids, carbohydrates, soluble proteins, together with the analysis of the enzymatic antioxidant activity of *Ulva*, as well as the extraction of ulvan, a fundamental active constituent of *Ulva* species with practical applications in a wide variety of fields, supports the exploitable potential of the green algae *U. rigida* and *U. intestinalis* from the Romanian Black Sea coast.

The nutritional value of *Ulva* algae is related to their biochemical profile. The utilization of algae in various fields such as pharmaceuticals, industry, cosmetics, etc. is closely linked to their biochemical composition. Thus, the water content of the two species is similar, very high, almost 80% in the case of *U. intestinalis* and about 77% in the case of *U. rigida*. The rest represents the dry weight, of which 5% is organic matter and more than 15% ash in the case of *U. intestinalis*, and only 1.21% organic matter and about 22% ash in the case of *U. rigida*. Of all the biochemical constituents, the protein percentage was the highest in both *U. intestinalis* (10.8%) and *U. rigida* (7.61%). Regarding total carbohydrates, *U. intestinalis* showed a higher percentage, of 9.09%, compared to *U. rigida*, which recorded a percentage of 3.46%. The percentage of total lipids was similar for the two *Ulva* species from the Romanian Black Sea coast, slightly higher for *U. intestinalis* (2.66% of dry biomass) compared to *U. rigida* (2.26% of dry biomass). The fundamental active constituent of *Ulva* is the soluble fibre ulvan, a gelling sulfated polysaccharide with biological activities including immunomodulating, antiviral, antioxidant, antihyperlipidemic and anticancer (Kidgell et al., 2019). Ulvans have a wide range of applications, as food additives, for making packaging, cosmetics, medicines, pharmaceuticals and in agriculture. The versatility of ulvans lies in their ability to form hydrocolloid particles, gels, 3D hydrogels, nanofibers, with the most diverse applications (Kraithong, 2024). A significant amount of ulvan was extracted from *U. rigida*, about 12% of the dry biomass, while only about 1% of the dry biomass was evidenced in *U. intestinalis*.

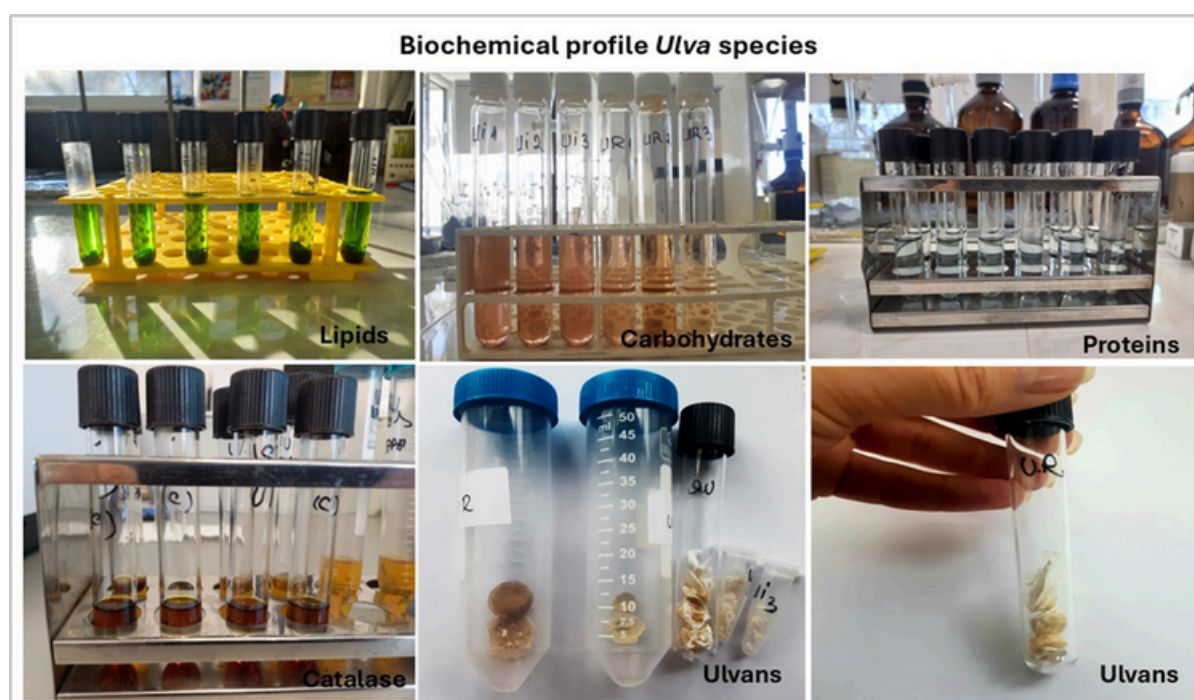


Fig. 3. Biochemical profile of *U. intestinalis* and *U. rigida* and aspects of ulvan extract (original photo NIMRD "Grigore Antipa")